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THE WHIPPING QUALITY OF CREAM.

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FACTORS INFLUENCING WHIPPING QUALITY.

The increasing use of whipped cream, both commercially and in the home, has brought with it a demand for greater knowledge concerning the factors which influence the whipping qualities of cream. It is a subject which has received but little attention. Some reports have been published closely related to the subject but dealing mostly with the effect of adding different substances to the cream and the effect of butterfat content and acidity upon its whipping quality. No accurate means of comparison were employed. Neither was information furnished to the housewife or confectioner as to the best kind of cream to purchase for whipping, nor to the dealer as to the kind of cream he should endeavor to supply in order to assure satisfaction among his customers.

Whipped cream is a valuable food. It is generally considered an appetizing delicacy only and is used as the basis of many desserts, or to garnish, improve, or extend others; but when thus used it increases the food value of the dish.

It is not the aim of this bulletin to explain how to whip cream or how to make cream whip. Its object is to show the whipping quality of cream, in order that both dealers and purchasers may know what is to be desired as a whipping cream.

There are many factors which influence the whipping quality of cream, but it is impossible to discuss them in the order of their importance, because one factor is sufficient to render what would otherwise be an excellent whipping cream useless for whipping purposes. The most important factors are: Kind of cream, age, butterfat content, and temperature.

EXPERIMENTAL PROCEDURE.

The same method of whipping was followed throughout this experiment. One hundred cubic centimeters of cream were placed in a 600 c. c. beaker, which was put in a dish and surrounded with ice to keep the temperature 45° F. or below (except when determining the effect of temperature upon the whipping quality). The cream was then whipped with an ordinary "Dover" egg beater. As this beater is operated by hand, it is impossible to determine the speed accurately. Approximately, however, 200 revolutions per minute of the handle were made, which gave a speed of 1,000 revolutions per minute of the whipping blades. All factors relating to the method of whipping, quantity whipped, and temperature remained constant throughout the experiment, so that any change in the whipping quality was due to some other factor or factors—not to a change in the method of procedure.

The acidity of the cream was determined by titrating with tenth-normal alkali, phenolphthalein being used as the indicator.

The time recorded in the various tables is the time of continuous whipping required to obtain the maximum whip, except in cases where the cream failed to whip; in such cases the maximum stiffness remained the same, or so nearly the same that it was impossible to determine when the maximum was reached. In all cases the cream was whipped for a longer time than recorded, in order to be certain that the maximum whip had been obtained.

METHOD OF COMPARING STIFFNESS OF WHIPPED CREAM.

In order to determine the relative stiffness of different samples of whipped cream it is necessary to have some device that will measure comparative stiffness. The methods usually employed for measuring viscosity are as a rule too complicated to admit of practical application.

The following simple method will enable any one to test the stiffness of different whipped creams very satisfactorily. It is, however, purely a relative measure intended for direct comparison of different creams and the determinations are not comparable with those obtained on the basis of other standards.

The apparatus is in the form of a balance. (Fig. 1.) The right arm of the balance is divided into 60 equal spaces, zero being at the

end, and is provided with a sliding weight. To the left arm a metal disk is suspended of such weight as to form a balance when the sliding weight is at zero. For each space that the sliding weight is moved the pressure exerted increases approximately 1 gram per square inch. The scale reading used throughout this bulletin may be interpreted as the approximate pressure per square inch in grams required to displace the cream. The pressure required to force the disk into the whipped cream was determined and used as a measure of the stiffness or quality of the whips.

The following descriptions may be applied to the various scale readings:

Scale reading.	Description.
Below 6	Failed to whip.
7 to 12	Very poor whip.
13 to 15	Poor whip.
16 to 20	Fair whip.
21 to 24	Satisfactory whip.
25 to 30	Good whip.
31 to 35	Very good whip.
36 and above	Excellent whip.

An idea of the comparative scale readings can be obtained by referring to Figures 2 to 6, inclusive, which show whipped creams of various qualities.

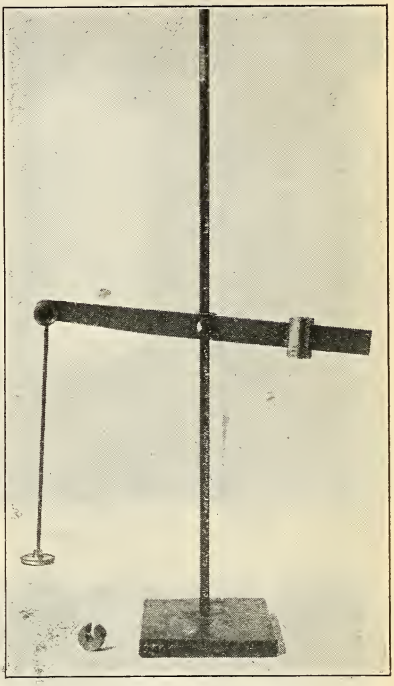

FIG. 1.—Balance for determining the relative stiffness of whipped creams.

RELATION OF VARIOUS FACTORS TO WHIPPING QUALITY.

Cream may be divided into four classes—raw cream, pasteurized cream, homogenized raw cream, and homogenized pasteurized cream. Homogenized raw cream is seldom found on the market.

RAW CREAM.

For whipping purposes raw cream ranked first. It whipped under more adverse conditions than any of the other three, and if it is of good quality, from a sanitary and health standpoint, its use for whipping purposes is highly recommendable.

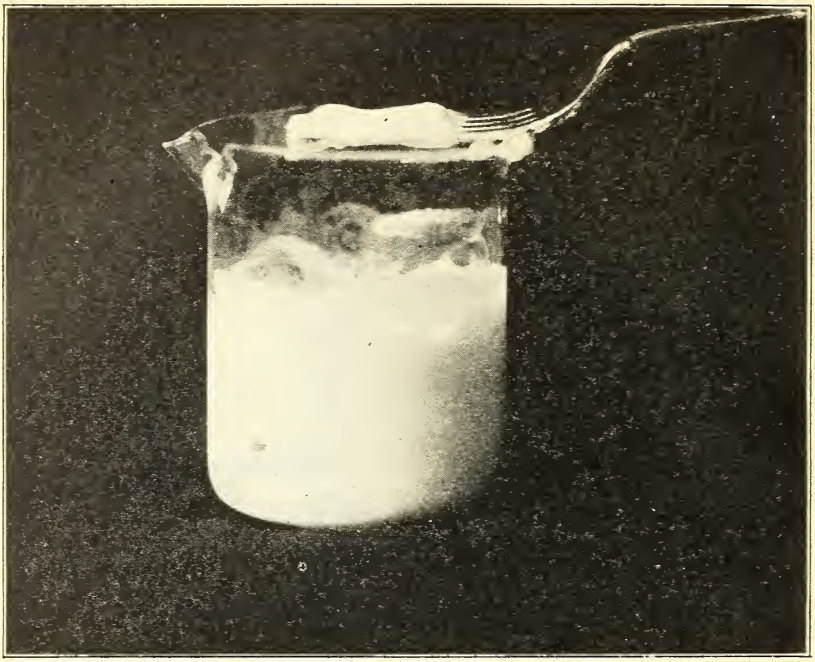

FIG. 2.—Whipped cream with scale of stiffness reading of 8.

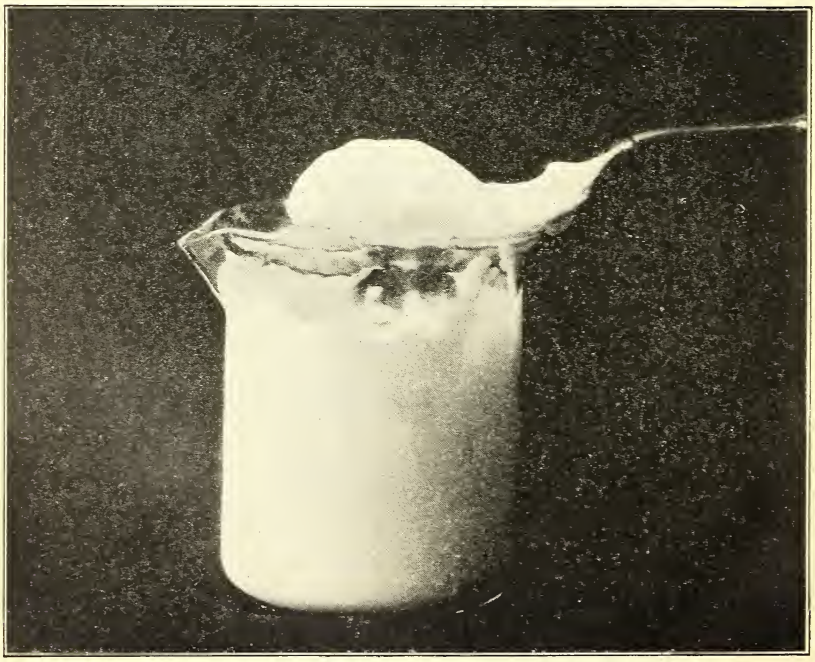

FIG. 3.—Whipped cream with scale of stiffness reading of 20.

FIG. 4.—Whipped cream with scale of stiffness reading of 30.

FIG. 5.—Whipped cream with scale of stiffness reading of 40.

FIG. 6.—Whipped cream with scale of stiffness reading of 50.

TABLE 1.—*Effect of age on whipping quality of raw cream.*

Age.	Acidity.		Average time of whipping.	Scale of stiffness.
	High.	Low.		
Hours.	*Per cent.*	*Per cent.*	*Minutes.*	
2	0.121	0.090	15	4
24	.153	.123	10	8
48	.156	.126	10	12
72	.211	.126	8	16
84	.218	.135	8	20
96	.218	.144	6	24
120	.238	.157	6	26
22 PER CENT CREAM.				
2	0.121	0.090	15	4
6	.121	.117	15	8
12	.139	.117	12	12
24	.139	.123	10	20
48	.168	.135	8	26
72	.144	.127	7	30
96	.200	.144	6	32
120	.243	.154	6	32
25 PER CENT CREAM.				
2	0.121	0.090	15	6
6	.121	.111	12	16
24	.153	.117	8	24
48	.162	.117	6	29
72	.171	.135	6	34
96	.200	.144	5	36
120	.250	.158	5	36
27 PER CENT CREAM.				
2	0.121	0.090	10	12
6	.121	.111	8	20
12	.134	.111	7	28
24	.153	.117	6	32
48	.162	.117	5	38
72	.171	.138	4	44
96	.200	.144	3	44
120	.250	.158	3	44
30 PER CENT CREAM.				
2	0.121	0.090	8	20
6	.121	.111	6	40
12	.134	.111	5	44
24	.153	.117	4	48
48	.162	.117	3	52
72	.171	.138	2	52
96	.200	.144	2	52
120	.250	.158	2	52

PASTEURIZATION.

Pasteurized cream ranks next to raw cream for whipping purposes. Although pasteurization is slightly detrimental to the whipping quality, this disadvantage often is more than counterbalanced by the assured safety from the health standpoint from the use of such cream.

A study of Figure 7 and a comparative study of Tables 1 and 2 show the influence of pasteurization on the whipping quality of cream. Practically all the results from which these tables were compiled were obtained from samples of the same cream, a part of which

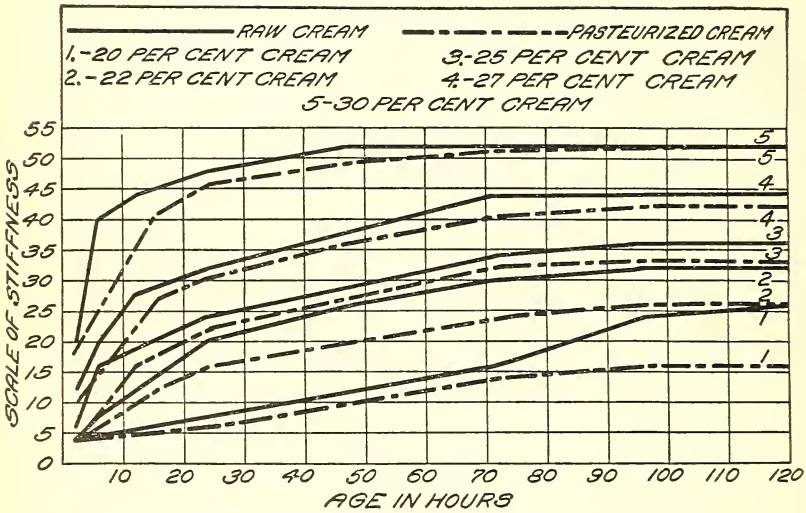

FIG. 7.—Effect of pasteurization on whipping quality of cream.

was pasteurized at 145° F. for 30 minutes. Both the pasteurized and the raw cream were aged under the same conditions, so that any difference in the whipping quality was due to pasteurization.

Pasteurized cream requires greater aging to obtain the maximum whip than raw cream, all other conditions being identical. In the case of cream containing less than 30 per cent butterfat the maximum whip does not equal the maximum for raw cream. It was impossible to obtain a satisfactory whip with the 20 per cent pasteurized cream, whereas with the 20 per cent raw cream a satisfactory whip was obtained after 96 hours of aging. However, it is only necessary to use pasteurized cream with a slightly higher butterfat content to obtain as good a whip as can be obtained from raw cream.

TABLE 2.—*Effect of age on whipping quality of pasteurized cream.*

Age.	Acidity.		Average time of whipping.	Scale of stiffness.
	High.	Low.		
Hours.	*Per cent.*	*Per cent.*	*Minutes.*	
20 PER CENT CREAM.				
2	0.134	0.112	15	4
15	.144	.112	15	5
24	.148	.117	12	6
48	.158	.126	12	10
72	.185	.130	10	14
96	.190	.144	8	16
120	.200	.153	8	16
22 PER CENT CREAM.				
2	0.103	0.090	15	4
15	.117	.111	12	12
24	.144	.121	10	16
48	.148	.127	10	20
72	.170	.132	8	24
96	.178	.135	8	26
120	.200	.135	8	26
25 PER CENT CREAM.				
2	0.111	0.090	10	4
6	.117	.108	10	8
12	.117	.108	10	16
24	.143	.121	8	22
48	.148	.125	8	27
72	.173	.130	6	32
96	.185	.137	5	33
120	.200	.143	5	33
27 PER CENT CREAM.				
2	0.111	0.090	10	10
15	.121	.117	7	26
24	.143	.121	6	30
48	.148	.125	6	36
72	.173	.130	5	40
96	.185	.137	4	42
120	.200	.143	4	42
30 PER CENT CREAM.				
2	0.111	0.090	8	18
15	.117	.111	5	40
24	.143	.121	5	45
48	.148	.125	4	49
72	.173	.130	3	51
96	.185	.137	3	52
120	.200	.147	3	52

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HOMOGENIZATION.

It is undesirable to homogenize cream if it is to be used for whipping purposes. The breaking up of the fat globules by homogenization gives the cream a heavy appearance so that one would think it would be excellent for whipping purposes. But the breaking up of the fat globules also destroys the ability of the cream to incorporate air, and thus impairs its whipping quality. The more thoroughly the fat globules are broken up, or, in other words, the higher the homogenizing pressure, the less the value of the cream for whipping purposes.

Effect of homogenizing.—The detrimental effect of homogenization may be seen by a comparative study of Tables 1 and 3 and in Figure 8. In all cases a sample of the raw cream was whipped both

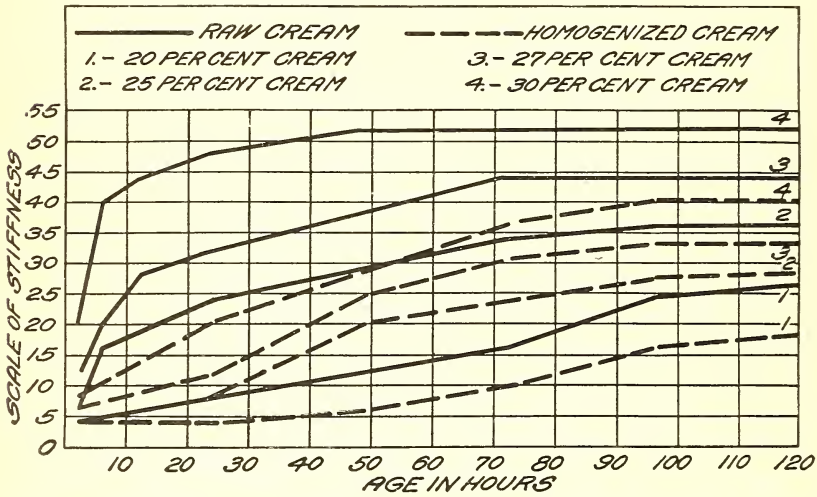

FIG. 8.—Effect of homogenizing at 3,000 pounds' pressure on whipping quality of cream.

before and after homogenizing in order to determine its effect on the whipping quality of the cream.

Figure 8 and Table 3 show that only a fair whip can be obtained from 20 per cent homogenized cream, while 25 per cent homogenized cream gives a satisfactory whip which is only 2 points higher on the scale of stiffness than a whip from 20 per cent raw cream. Thirty per cent homogenized cream gives a whip midway in quality between the 25 per cent and 27 per cent raw creams. In other words, a 20 per cent raw cream is nearly equal to a 25 per cent homogenized cream, and a 27 per cent raw cream is considerably better than a 30 per cent homogenized cream for whipping purposes. Furthermore, the average time required to whip homogenized cream was much greater than that required for raw cream.

A comparative study of Tables 1 and 2 with Table 3 reveals the fact that for whipping purposes homogenized cream comes nearer equaling pasteurized cream than it does raw cream. Homogenization, however, has a more detrimental effect than pasteurization upon the whipping quality of cream. In all cases except that of the 20 per cent grade, pasteurized cream far excelled homogenized cream for whipping.

TABLE 3.—*Effect of age on whipping quality of raw homogenized cream.*

Age.	Acidity.		Average time of whipping.	Scale of stiffness.
	High.	Low.		
Hours.	*Per cent.*	*Per cent.*	*Minutes.*	
2	0.117	0.111	15	4
24	.143	.121	15	4
48	.175	.143	12	6
72	.195	.176	12	10
96	.200	.196	10	16
120	.247	.200	10	18
25 PER CENT CREAM.				
2	0.121	0.117	15	4
24	.153	.125	12	8
48	.181	.156	10	20
72	.195	.184	9	24
96	.217	.197	9	27
120	.243	.200	7	28
27 PER CENT CREAM.				
2	0.121	0.117	15	6
24	.153	.121	12	12
48	.180	.153	10	24
72	.196	.180	9	30
96	.200	.196	7	33
120	.236	.200	7	33
30 PER CENT CREAM.				
2	0.121	0.117	15	8
24	.153	.121	12	20
48	.180	.153	10	28
72	.196	.180	9	36
96	.200	.196	7	40
120	.236	.200	7	40

HOMOGENIZING PRESSURE.

The effect of homogenizing cream at different pressures is shown in Figure 9 and Table 4, which were compiled from tests of samples of the same cream; that is, the sample receiving no pressure was taken before homogenizing and the remaining samples were obtained at various pressures, so that any difference in whipping quality was due to homogenizing.

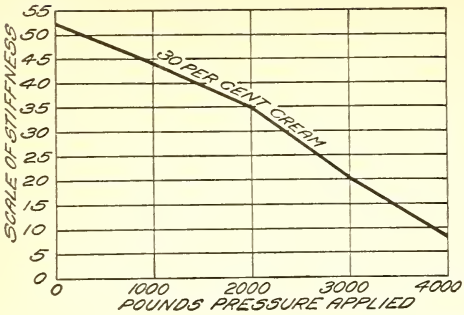

FIG. 9.—Relation of homogenizing pressure to whipping quality of cream.

The whipping quality of cream is inversely proportional to the homogenizing pressure, i. e., an increase in pressure produces a decrease in the whipping quality to such an extent that raw cream which will give a whip with a scale reading of 52 fails to whip when homogenized at 4,000 pounds' pressure. It is also true that as the quality of the whip decreases the time required to obtain the maximum whip increases.

TABLE 4.—*Relation of homogenizing pressure to whipping quality of cream.*

Pressure.	Average time of whipping.	Scale of stiffness.
Pounds.	*Minutes.*	
0	3	52
1,000	3	44
2,000	8	35
3,000	12	20
4,000	15	8

COMBINED PASTEURIZING AND HOMOGENIZING.

Pasteurizing at 145° F. and homogenizing at 3,000 pounds' pressure, together, have a detrimental effect upon the whipping quality

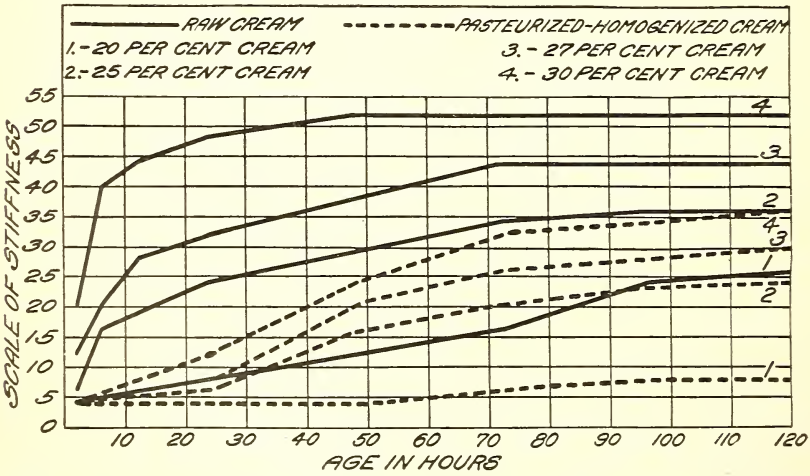

FIG. 10.—Effect of pasteurizing and homogenizing combined on whipping quality of cream.

of cream equal to the sum of the detrimental effects produced by the processes separately, when compared with raw cream.

The effect is such that it is impossible to obtain even a fair whip from such cream containing less than 25 per cent butterfat. Twenty per cent cream failed to whip, and 30 per cent cream gave a maximum whip equal only to a 25 per cent raw cream. (See Fig. 10 and compare Tables 1 and 3 with Table 5.)

TABLE 5.—*Effect of age on whipping quality of pasteurized-homogenized cream.*

Age.	Acidity.		Average time of whipping.	Scale of stiffness.
	High.	Low.		
Hours.	*Per cent.*	*Per cent.*	*Minutes.*	
2	0.111	0.090	15	4
24	.117	.111	15	4
48	.143	.121	15	4
72	.148	.125	15	6
96	.173	.130	12	8
120	.200	.161	12	8
25 PER CENT CREAM.				
2	0.117	0.111	15	4
24	.121	.117	12	6
48	.132	.121	12	16
72	.152	.136	10	20
96	.176	.157	9	23
120	.200	.180	9	24
27 PER CENT CREAM.				
2	0.117	0.111	15	4
24	.121	.117	12	8
48	.136	.121	11	20
72	.157	.136	10	26
96	.180	.157	9	28
120	.200	.180	8	30
30 PER CENT CREAM.				
2	0.117	0.111	15	4
24	.121	.117	12	12
48	.136	.121	10	24
72	.157	.136	9	32
96	.180	.157	8	34
120	.200	.180	7	36

AGE.

Age is an important factor in the whipping of cream. Fresh cream which fails to whip often develops into an excellent whipping cream when aged at a temperature sufficiently low (45° F.) to prevent the rapid formation of acidity. Age in this bulletin refers to time after separation of raw cream and after pasteurization or homogenization of cream undergoing those processes.

Care must be used in aging cream. If the temperature exceeds 50° F. the cream will very likely become sour before the desired effect of the aging takes place. It is also likely to become rancid or develop

off flavors when aged for more than 48 hours, unless under ideal conditions.

The required time for aging varies with the butterfat content and the kind of cream. However, the first 24 hours show the most marked effect upon whipping quality of all cream; and the greatest effect takes place during the first 48 hours, after which the increase in whipping quality is very gradual.

Raw cream.—In the case of raw cream containing a low per cent of butterfat, continued aging improves the whip; for instance, 20 per cent raw cream improves with age until 120 hours old, and 22 to 25 per cent raw cream does not reach the maximum whip until 96 hours old. Cream containing 27 per cent or more of butterfat usually reaches the maximum whipping point after 48 hours of aging and shows no material increase in quality after 72 hours. However, with raw cream containing 22 or more per cent of butterfat a satisfactory

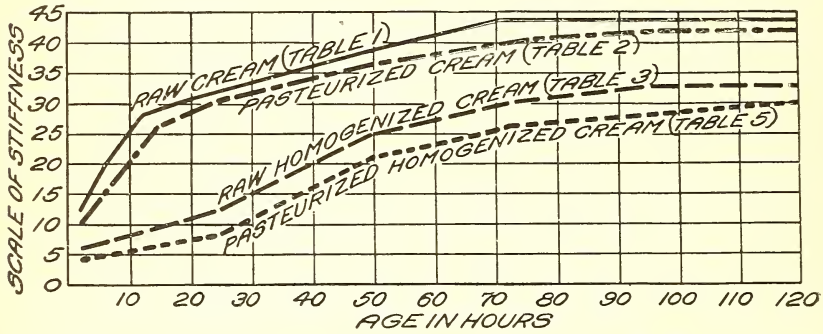

FIG. 11.—Effect of age on whipping quality of 27 per cent cream.

whip can be obtained by aging for 48 hours. (See Table 1 and Fig. 11.)

Pasteurized cream.—A study of Table 2 and Figure 11 reveals the following facts: Twenty per cent pasteurized cream fails to give a satisfactory whip even when aged for 120 hours. Pasteurized cream with a butterfat content ranging from 22 to 27 per cent reaches the maximum whip at 96 hours of age. Thirty per cent pasteurized cream attains its maximum whip when 72 hours old. However, a satisfactory whip can be obtained from pasteurized cream in excess of 22 per cent butterfat at 48 hours of age. The increase in whipping quality which comes from aging longer than 48 hours is gradual.

Homogenized raw cream.—The effect of age upon the whipping quality of cream, homogenized at 3,000 pounds' pressure, is practically the same as upon raw or pasteurized cream. As previously stated, homogenization is very detrimental to the whipping quality of cream, and as a result greater aging is required to obtain the maximum whip. (See Fig. 11 and Table 3.)

Pasteurized-homogenized cream.—The whipping quality of cream homogenized at 3,000 pounds' pressure and pasteurized at 145° F. for 30 minutes is likewise improved by age, as is shown in Table 5 and Figure 11. However, it should be noted that the aging required to obtain the maximum whip is much longer than for raw or pasteurized cream.

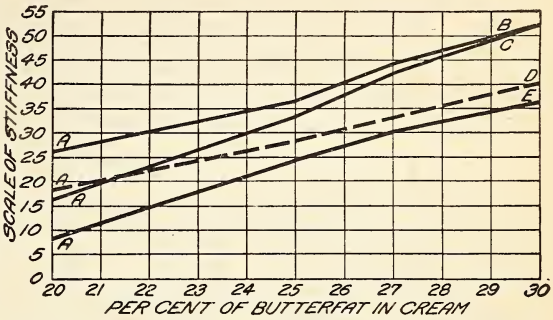

FIG. 12.—Effect of butterfat content on whipping quality of cream. Maximum whips obtained from: A—B, raw cream; A—C, pasteurized cream; A—D, homogenized cream; A—E, homogenized-pasteurized cream.

BUTTERFAT CONTENT.

Butterfat content has a marked influence upon the whipping qualities of cream (Table 6 and Fig. 12). Increasing the butterfat content up to 30 per cent greatly improves the whipping quality. The work showed that an increase beyond 30 per cent gave no additional improvement in the quality of the whip, but it did give a decrease in the time required to whip.

TABLE 6.—*Effect of an increase in butterfat content of cream on whipping quality.*

Butterfat content.	Maximum scale reading.			
	Raw cream.	Pasteurized cream.	Homogenized cream.	Pasteurized homogenized cream.
Per cent.				
20	26	16	18	8
22	32	26	.....	.....
25	36	33	28	24
27	44	42	33	30
30	52	52	40	36

The effect of butterfat content is especially marked in comparatively fresh cream, i. e., 24 hours or less of age. For example, fresh cream with a low butterfat content fails to whip, whereas fresh cream with a 27 per cent or 30 per cent butterfat content, while not giving anywhere near the maximum whip at this age, does give a satisfactory one. (See Table 1.) It is therefore important to consider the butterfat content of cream if it is to be whipped when less than 48 hours old. For whipping purposes no cream containing less than 22 per cent butterfat can be recommended. Although a satisfactory whip can be obtained from 20 per cent raw cream by aging

for 96 hours, there is great danger of it's being off flavor or sour when held for this length of time.

TEMPERATURE.

Temperature plays an important part in whipping cream. As is the case with all other factors affecting whipping quality, temperature has its greatest influence upon cream of low butterfat content. However, the quality of whip from such cream does not improve with a decrease in temperature below 45° F., and with cream containing 27 per cent or more of butterfat does not improve with a decrease in temperature below 50° F.

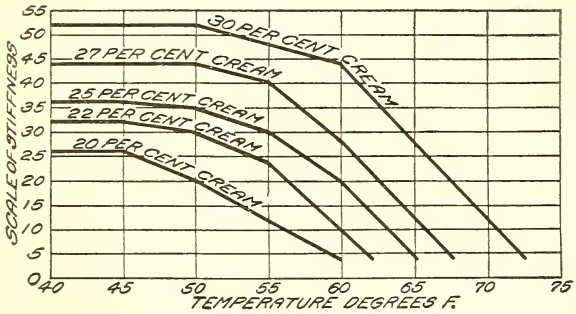

FIG. 13.—Effect of temperature on whipping quality of cream.

An increase in temperature above 50° F. causes a decrease in the stiffness of the whip which is in direct ratio to the increase in temperature. Its effect is such that 20 per cent cream fails to whip at 60°; 22 per cent cream fails at 62°; 25 per cent cream fails at 68°; and 30 per cent cream fails at 72.5°. (See Table 7 and Fig. 13.)

To insure good results, therefore, cream containing a low per cent of butterfat should be whipped at a temperature not greater than 45° F., and cream containing 27 per cent butterfat or more should be whipped at a temperature not exceeding 50° F.

TABLE 7.—*Effect of temperature of raw cream on whipping quality.*

Temperature.	Scale of stiffness.				
	20 per cent cream.	22 per cent cream.	25 per cent cream.	27 per cent cream.	30 per cent cream.
°F.					
40	26	32	36	44	52
45	26	32	36	44	52
50	20	30	35	44	52
55	12	24	30	40	48
60	4	10	20	28	44
62	.....	4	.....	.....	.....
65	.....	.....	4	12	28
67.5	.....	.....	.....	4	.....
70	.....	.....	.....	.....	12
72.5	.....	.....	.....	.....	4

ACIDITY.

It has often been noticed that cream which is several hours old will whip better than fresh cream. Because of this it was believed that the small amount of acidity developed in the cream influenced its whipping equality. Also the idea is prevalent that adding a small amount of commercial lactic acid to the cream improves its whipping quality. In order to compare the effect of acidity with the effect of age, tests were made on cream representing age without acidity, acidity without age, and both age and acidity. The acidity was obtained both by the natural formation of acid and by adding lactic acid.

The maximum acidity which cream may contain without acquiring a sour taste is about 0.3 per cent. It was found that increasing the acidity up to and including 0.3 per cent had no effect upon the quality of the whip. (See Fig. 14 and Table 8.) Increasing the acidity in excess of 0.3 per cent caused a slight decrease in the quality of the

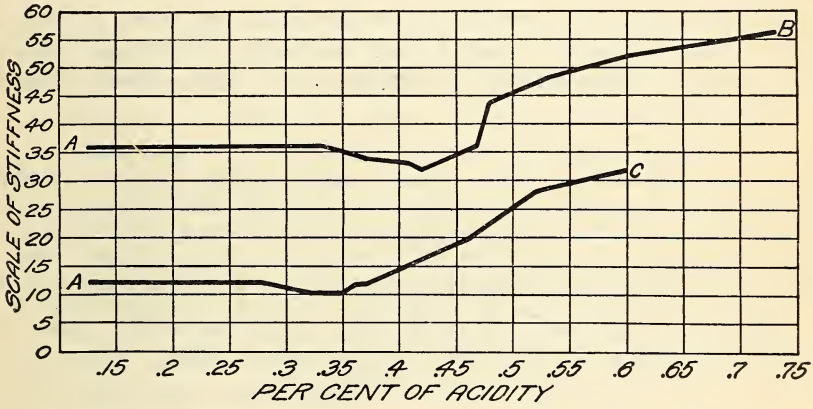

FIG. 14.—Effect of increase in acidity on whipping quality of cream. A—B, cream which gives a good whip; A—C, cream which gives a very poor whip.

whip until the acidity had increased to such an extent that the cream began to curdle, at which point the whipping quality increases. This was found to be true regardless of whether fresh or aged cream was used.

It is therefore evident that increasing the acidity of cream will not improve its whipping quality, as it is necessary to increase the acidity to such an extent as to render the cream sour before it will have any effect.

TABLE 8.—*Effect of increasing the acidity on whipping quality of good and poor whipping creams.*

Good whipping cream.			Poor whipping cream.		
Acidity.	Time of whipping.	Scale of stiffness.	Acidity.	Time of whipping.	Scale of stiffness.
Per cent.	*Minutes.*		*Per cent.*	*Minutes.*	
0.126	3	36	0.126	5	12
.135	3	36	.135	5	12
.193	3	36	.193	5	12
.234	3	36	.219	5	12
.265	3	36	.265	5	12
.333	3	36	.279	5	12
.373	3	34	.328	5	10
.409	3	33	.346	5	10
.423	3	32	.363	5	12
.468	3	36	.369	5	12
.477	3	44	.419	5	16
.531	3	48	.463	5	20
.603	3	52	.522	5	28
.733	3	56	.607	5	32

VISCOGEN.

The viscogen in these studies was prepared and used according to directions given by Babcock and Russell in Wisconsin Bulletin No. 54, "The Restoration of Consistency of Pasteurized Cream," which are as follows:

> Two and one-half parts by weight of a good quality of cane sugar (granulated) are dissolved in 5 parts of water; and 1 part of quicklime gradually slaked in 3 parts of water. This milk of lime should be poured through a wire strainer to remove coarse unslaked particles and then added to the sugar solution. The mixture should be agitated at frequent intervals and after two or three hours allowed to settle until the clear supernatant fluid can be siphoned off.

When properly used, viscogen has a beneficial effect upon the whipping quality of both raw and pasteurized cream. But the increase is not to the extent that an excellent whip should be expected from a poor quality whipping cream. Neither should it be expected that viscogen will give a good whip when other conditions are unfavorable. Viscogen will not overcome the detrimental effect of homogenization.

However, viscogen, on account of its strong alkaline character, must be used with care. Under no circumstances should sufficient quantities be added to render the cream alkaline, for when added to this extent the effect becomes detrimental instead of beneficial. Therefore, before adding viscogen to cream, the amount required to neutralize it should be determined. This can be done by adding phenolphthalein indicator to a known amount of cream and titrating with viscogen. When the amount required to neutralize the cream has been determined, a slightly less quantity of viscogen should be

used. Seldom should more than 1 part by volume of viscogen be added to 100 parts of the cream, and more often 1 part by volume of viscogen to 150 parts of cream is better.

When carefully used in this manner a fair whip can be obtained from cream which would otherwise fail to whip, and a good whip can be obtained from cream which without viscogen gives only a fair whip. In other words, adding viscogen in the proper amount increases the stiffness scale reading from 6 to 16 and from 16 to 28, respectively, of the different creams.

Viscogen should not be added to cream which is to be sold without first consulting Federal, State, and city laws in regard to its use and labeling.

SUGAR.

Adding sugar either before or after whipping cream decreases the stiffness. When added at the rate of 2 teaspoonfuls to 100 c. c. of cream, the decrease in stiffness is 4 points on the scale for each of the different grades of cream. (Table 9.) There is no difference between the effects of granulated sugar and of powdered sugar. Decreasing the amount of sugar decreases the effect until, when added at the rate of 1 teaspoonful to the half pint, it has no effect.

Adding sugar before whipping not only decreases the maximum whip but increases the time of whipping (Table 10), when compared with cream to which sugar has not been added. When compared with cream to which sugar was added after whipping, the stiffness is the same; also when the time required to dissolve the sugar in the whipped cream is taken into consideration, the time of whipping is the same. The results are identical, regardless of whether granulated or powdered sugar is used. If added previous to whipping, there is a certainty that it will be thoroughly dissolved and distributed throughout the cream.

TABLE 9.—*Effect of adding sugar*[1] *after whipping on quality of whipped cream.*

Butterfat content.	Time of whipping.	Scale of stiffness.	
		Normal cream.	Cream with sugar added.
Per cent.	*Minutes.*		
22	6	28	24
25	5	32	28
27	4	40	36
30	3	52	48

[1] Two teaspoonfuls of granulated sugar were added to 100 c. c. of whipped cream, and the cream was whipped for one minute to dissolve the sugar. Confectioner's powdered sugar added, instead of granulated sugar, gave the same results.

TABLE 10.—*Effect of adding sugar*[1] *before whipping on quality of whipped cream.*

Butterfat content.	Time of whipping.	Scale of stiffness.		
		Normal cream.	Cream with sugar added.	Cream with sugar added and 1 minute longer whipping.
Per cent.	*Minutes.*			
22	6	28	16	24
25	5	32	22	28
27	4	40	30	36
30	3	52	44	48

[1] Two teaspoonfuls of granulated sugar were added to 100 c. c. of cream before whipping. The experiment was repeated, using the same quantity of powdered sugar, with the same results.

FLAVORING EXTRACT.

Flavoring extract, whether added before or after whipping, affects neither the stiffness of the whip nor the whipping quality. It is preferable to add the extract previous to whipping, as the cream will whip as readily, and time is saved in that the extract is thoroughly mixed through the cream by the time the whipping is completed.

Adding flavoring extract with sugar produces the same effect as though only sugar were added.

"STANDING-UP" QUALITY OF WHIPPED CREAM.

This investigation would not be complete without considering the standing-up quality, or the ability of the whipped cream to retain its stiffness. There are three important and closely related factors affecting the standing-up quality, i. e., temperature, stiffness of the whip, and butterfat content.

If whipped cream could be kept at or below 50° F., it would continue to stand up for several days. With a rise in temperature the stiffness decreases, varying with the increase in temperature and the stiffness of the whip. The effect of a rise in temperature is such that a whip of low quality may become practically useless if allowed to remain at a temperature higher than 65° F. While there is a slight decrease in the stiffness of the better-quality whips with a rise in temperature, it is less marked, and such whips may be held for several hours without falling.

Although an increase in butterfat content beyond 30 per cent does not improve the stiffness of the whip, it does enable the whip to stand up for a longer time and at a temperature that would seriously affect cream with a low butterfat content.

The effect of viscogen upon the standing-up quality is only equivalent to the degree to which it improves the stiffness of the whip.

As previously stated, a satisfactory whip can be obtained from either raw cream with a butterfat content of 20 per cent or more, or from pasteurized cream with a butterfat content in excess of 22 per cent. But because the very purpose for which cream is whipped usually prevents it from being kept at a low temperature, it is recommended that cream for whipping purposes should contain 25 per cent or more butterfat, and that it should be aged for approximately 48 hours before whipping.

WHIPPING QUALITY OF POWDERED CREAM.

Reconstituted cream made from powdered cream and containing as high as 40 per cent butterfat failed to whip. Its whipping quality was not improved by the use of viscogen or by aging. Powdered cream, therefore, may be considered useless for whipping purposes.

WHIPPING QUALITY OF EVAPORATED MILK.

The standard brands of evaporated milk used undiluted whipped but did not stand up. When whipped in the same manner as cream at a low temperature (45° F.) evaporated milk gave a fairly dense whip in from 5 to 7 minutes. But the result is temporary, and if the whip is removed from the ice it returns to its normal condition or consistency in approximately the same time that was required to obtain the whip.

Viscogen added to the extent of 1 per cent failed to improve either the whipping quality or the standing-up quality of the whip. It is therefore evident that evaporated milk is practically valueless for whipping purposes.

SUMMARY.

1. Raw cream excels pasteurized, homogenized, and pasteurized-homogenized cream in whipping quality.
2. Pasteurization is slightly detrimental to the whipping quality of cream, and especially so in the case of cream with a butterfat content below 23 per cent.
3. Homogenization is very detrimental to the whipping quality of cream. The higher the homogenizing pressure the poorer the whipping quality.
4. Homogenizing and pasteurizing combined practically destroy the value of cream for whipping purposes.
5. The whipping quality of cream, regardless of whether the cream contains a high or a low per cent of fat, or whether it is raw, pasteurized, homogenized, or pasteurized-homogenized, is improved by age. However, the age required to obtain a satisfactory whip varies with the kind of cream and the per cent of butterfat. In every case the

most rapid changes occur in the first 48 hours and at 72 hours nearly the maximum whip is obtained.

6. The whipping quality of cream improves with an increase in butterfat content up to 30 per cent, after which the quality of the whip shows no marked increase, but the standing-up quality is improved and there is a decrease in the time required to whip.

7. Temperature is an important factor in the whipping of cream. To insure good results the temperature of the cream should not exceed 45° F.

8. Increasing the acidity, either by adding lactic acid or by allowing the natural formation of acid, does not affect the whipping quality until the acidity content exceeds 0.3 per cent, at which time the cream acquires a sour taste.

9. Viscogen, when properly used, increases the whipping quality of raw or pasteurized cream, and does not affect its flavor.

10. Sugar, when added in quantity sufficient to sweeten thoroughly, decreases the quality of the whip regardless of whether added before or after whipping—the smaller the amount added, the less the effect.

11. Flavoring extract, added in quantity sufficient to flavor, affects neither the whipping quality nor the quality of the whip.

12. Temperature, quality of the whip, and butterfat content are the important factors affecting the standing-up quality of whipped cream.

13. Powdered cream is useless for whipping purposes.

14. Although evaporated milk will whip, it is not useful for whipping purposes because it will not stand up.

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